

## RETRACTABLE ANGLED ANTENNA ASSEMBLY

### TECHNICAL FIELD

This invention relates to antennas, and more specifically to a retractable or collapsible antenna assembly.

### BACKGROUND

In many radio communication applications, such as radios, cellular phones, the likes and their combinations, it becomes necessary to be able to reliably lower the communication device's antenna to reduce the size of the overall communication device. After the antenna is extended as a straight antenna, placed close to the user's head, as in a typical handphone usage, the close proximity of the extended straight antenna loads down the antenna's performance and reduces the antenna's gain.

When the communication device such as a radio and phone combination is used to make a phone call, the user brings the device next to his/her left or right ear and extends the device's antenna. Typical retractable antennas are designed in such a way that the antenna comes out of the radio straight up. The proximity of the user's head to the antenna has shown to degrade antenna performance considerably due to the antenna loading effect. In order to reduce the loading effects and therefore improve antenna efficiency it would be preferable to have the antenna tilted away from the user's head.

Some phone manufacturers have come up with a design to tilt the antenna by actually molding the antenna boss in an already tilted angle. A canted, tilted, or otherwise positioned antenna, angled away from the user's head, enabled by an angled antenna boss, has better gain characteristics as seen in U.S. Pat. No. 5,590,416. However, this solution presents several mechanical challenges as far as the interface required internally to providing the bending of the antenna without breakage and deformation to the antenna assembly. Furthermore, the angled boss design maybe objectionable to the user because of the sharp corner or otherwise bent physical appearance of such a canted antenna.

A need, therefore, exists for an antenna assembly which can overcome the above mentioned problems associated with present day radio antenna assemblies, without sacrificing aesthetics or mechanical reliability.

### BRIEF DESCRIPTION OF THE DRAWINGS

In FIG. 1 a communication device having an antenna assembly in accordance with the present invention is shown.

In FIG. 2 the same antenna assembly as shown in FIG. 1 is shown in the retracted position, in accordance with the present invention, with a cut-away view of the communication device.

In FIG. 3 the same antenna assembly as shown in FIG. 1 in the slanted extended position, is shown in a cut-away view of the communication device to see the cavity 134 enclosed within, in accordance with the present invention.

In FIG. 4 a simplified cross-sectional representation of the electromagnetic coupling within the same antenna topology of FIG. 6, is shown, in accordance with an alternate embodiment of the present invention.

In FIG. 5 a simplified cross-sectional representation of the non-electromagnetic coupling within the antenna topology of FIG. 2, is shown, in accordance with the present invention.

In FIG. 6 an antenna assembly having an alternate embodiment, in accordance with the present invention, is shown in the retracted position.

In FIG. 7 the same antenna assembly as shown in FIG. 6 is shown, in accordance with the present invention, in the slanted extended position.

In FIG. 8 the same housing support section 126, as shown in FIG. 6, is shown in a cut-away simplified view to see the tapered guide 138 enclosed within, in accordance with the present invention.

In FIG. 9 the same antenna stopper portion 402, as shown in FIG. 6, is shown in a simplified side view to see the correspondence with the tapered guide 138 enclosed within the housing support section 126 of FIG. 8, in accordance with the present invention.

In FIG. 10 the same antenna assembly as shown in FIG. 6 is shown, in accordance with the present invention, in the transitional state between the slanted extended position of FIG. 7 and the retracted position of FIG. 6.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1-3, a communication device such as a radio or radiophone combination 302 utilizing the antenna assembly 100 of the present invention is shown. An improved mounting arrangement is taught by means of a specially designed stopper portion 402 of the antenna element 114 (see FIG. 9) and the correspondingly shaped housing support or antenna boss 126 having a tapered guide 138 (see FIG. 9) to control the antenna tilting (see FIG. 7).

Referring to FIGS. 1-5, there is shown an antenna assembly 100 in accordance with the present invention where the end tip or bottom portion of the antenna 402 (more simply seen in FIG. 9) and the antenna cavity 134 or housing 126 (more simply seen in FIG. 8) have uniquely designed angled internal contours for automatic tilting (more simply seen in FIG. 7) of the antenna to decrease antenna loading. The present invention allows the tilting of an extended antenna assembly 100 in FIGS. 1, 3, and 7 without externally molding the antenna boss or other housing support 126 at an angle and without requiring fancy mechanical interfaces. The antenna element 114 of the antenna assembly 100 will reside straight down inside the radio when retracted as seen in FIG. 2 and FIG. 6.

In FIG. 1, the external parts of the antenna housing 144 is seen as a vertical housing support section or an antenna boss 126. This boss 126 can be an integral part of the radio housing 144 or a separate part that can be assembled onto the radio housing 144. When the user pulls the antenna "up" from the antenna boss 126, the entire length of the antenna naturally pulls back, from the boss 126, at a preferable fifteen degree angle due to the shape of the antenna tip, base, or bottom portion 402 being confined by the internal shape of the antenna housing, whether the internal channeling of the housing is formed of the boss 126, the radio housing 144, the cavity 134, a combination or a separate part. This slanted position allows the antenna to stay away from the user's head to reduce loading effects in order to increase antenna efficiency while the user is using the communication device as a phone. When the antenna is pushed "down", most of the length of the antenna naturally retracts straight back into the communication device housing 144 without being bent.

Basically, referring to FIG. 3, in accordance with the teachings of the present invention, an antenna assembly 100 includes an antenna element 114 having an expanded base portion 402 and a linear portion 116. In FIG. 4, the expanded